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Geography and allied disciplines have long debated the ontological relationship between nature and society. Although a binary perspective has historically predominated, recent decades have given rise to theories transgressing the nature–society divide through nondualist conceptualizations of socionatures. Proponents of actor-network theory (ANT) in particular have made the case for a nondualist approach focused on hybrid socionatural networks. Yet some scholars working in critical traditions such as political ecology reject ANT for reasons including insufficient attention to power and human intentionality. This article engages this debate, arguing that ANT's approach to socionatural networks is compatible with political ecology's core commitments and that drawing on ANT can help address enduring critiques of political ecology's privileging of the political and economic over the material. The article grounds its argument empirically by applying a political–ecological network approach to a conflict rooted in the neoliberal subsumption of nature at Peru's Lake Parón. In documenting the historical dynamics of socionatural articulation within the Parón waterscape, the case illustrates the potential of a network approach for understanding processes of assemblage and hybridization in ways that emphasize their historical-materialist character and the emergent agency of the social and natural—and socionatural—actors that they link. The article contends that such an approach not only yields a more comprehensive and symmetrical understanding of agency but can also support more just environmental governance by highlighting the contradictions between social reproduction and economic production that underlie many socioenvironmental conflicts under capitalism. *Key Words: actor-network theory (ANT), hydrosocial systems, political ecology, resource conflict, water governance.*

地理学和相关领域长期辩论自然与社会之间的本体论关系。尽管历史上盛行二元对立的观点, 但晚近数十年则见证了通过非二元的社会自然概念化兴起的超越自然—社会分隔的理论。特别是行动者网络理论（ANT）的提倡者, 更为聚焦混杂的社会自然网络之非二元对立方法提供了充分理由。但从事诸如社会生态学等批判传统研究的若干学者, 却仍以未能充分关注权力和人类意向等理由拒绝 ANT。本文涉入此一辩论, 主张 ANT 的社会自然网络方法与政治生态学的核心承诺相容, 且运用 ANT 能够有助于应对政治生态学偏好政治与经济而非物质的长期批判。本文通过应用政治生态网络方法来处理深植于秘鲁帕龙湖中有关自然的新自由主义次预设之冲突, 将此一主张植基于经验 。该案例在记录帕龙水景中的社会自然接合的历史动态中, 阐述以网络方法理解凑组和混杂的过程之潜能, 该方法强调其历史物质特徵, 及其所连结的浮现中的社会与自然之主体性、以及社会自然行的动者。本文主张, 此一方法不仅能对主体性有更为全面且匀称的理解, 并且通过强调凸显资本主义中诸多社会环境冲突的社会再生产与经济生产之间的矛盾, 能够支持更为公正的环境治理。*关键词：行动者网络理论*（ANT）, *水文社会系统, 政治生态学, 资源冲突, 水治理。*

Durante mucho tiempo la geografía y las disciplinas afines han debatido la relación ontológica entre naturaleza y sociedad. Aunque históricamente ha predominado una perspectiva binaria, en épocas recientes han surgido teorías que transgreden la divisoria naturaleza–sociedad por medio de conceptualizaciones no dualistas de socionaturalezas. Los partidarios de la teoría actor–red (ANT) en particular han propugnado por un enfoque no dualista enfocado a redes socionaturales híbridas. No obstante, algunos eruditos que trabajan en tradiciones críticas, tales como ecología política, rechazan la ANT por razones que incluyen la atención insuficiente que prestan al poder y a la intencionalidad humana. Este artículo se involucra en este debate arguyendo que el enfoque de la ANT a las redes socionaturales es compatible con los compromisos centrales de la ecología política, y que basándonos en la ANT se pueden abocar críticas perdurables a la ecología política por privilegiar lo político y lo económico sobre lo material. El artículo fundamenta empíricamente su argumento aplicando un enfoque de red político–ecológica a un conflicto arraigado en la subsunción neoliberal de la naturaleza en el Lago Parón del Perú. Documentando la dinámica histórica de la articulación

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socionatural dentro del paisaje hídrico del Parón, el caso ilustra el potencial de un enfoque de redes para entender los procesos de ensamble e hibridación en maneras que enfatizan el carácter histórico-materialista de la agencia emergente de los actores sociales y naturales—y socionaturales—que ellos vinculan. El artículo sostiene que tal enfoque no solo genera un entendimiento más comprensivo y simétrico de la agencia, sino que puede igualmente dar su apoyo a una gobernanza ambiental más justa destacando las contradicciones entre la reproducción social y la producción económica que subrayan muchos conflictos socioambientales bajo el capitalismo. *Palabras clave: conflicto por recursos, ecología política, gobernanza del agua, sistemas hidrosociales, teoría de actor–red (ANT).*

> We have mixed our labour with the earth, our forces with its forces too deeply to be able to draw back and separate either out. Except that if we mentally draw back, if we go on with the singular abstractions, we are spared the effort of looking, in any active way, at the whole complex of social and natural relationships which is at once our product and our activity.
>
> —Williams (1980, 83)

> More supple than the notion of system, more historical than the notion of structure, more empirical than the notion of complexity, the idea of network is the Ariadne's thread of these interwoven stories.
>
> —Latour (1993, 3)

On 29 July 2008, before the sun crested the glaciated summits of Peru's Cordillera Blanca, residents from the Cruz de Mayo *campesino* community and the city of Caraz ascended the long dirt road to Lake Parón. Other mornings, some might have made this same trip to clean irrigation canals or shuttle foreign mountaineers hoping to scale the peaks ringing the lake basin. That morning, however, they were on their way to banish one of the world's largest energy corporations from their lake by evicting a lone technician who managed the hydraulic valves controlling Lake Parón's outflow.

With their task accomplished, some of the coalition remained to guard the discharge-control station, as others descended to block the access road. Meanwhile, a diverse crowd—from schoolchildren to community elders—assembled in Caraz to proclaim their right to the lake that had long been a critical water source and cultural symbol in the region but that a decade earlier had fallen under foreign control. This coordinated resistance came only after years of appeals to authorities had effected too little change in the company's management of the lake. Since Lake Parón's occupation, nine years have elapsed; although the conflict has calmed, it remains unresolved.

This article analyzes the Parón conflict through a political–ecological lens, highlighting how social and biophysical factors have interacted to drive the conflict's emergence and persistence in a context of incompatible strategies of resource access and control. Viewed in this way, the case underscores the governance challenges ensuing from nature's neoliberalization: economic reforms disembed a vital resource from its existing sociocultural context, generating social resistance through a Polanyian double movement (Polanyi [1944] 2001). By detailing these dynamics, the article contributes to political ecology's rich scholarship on neoliberal natures and responds to the call for "more robust ethnographic accounts of the complex and place-based sets of practices through which particular actors have produced, reproduced, and challenged these novel modes of governance" (Himley 2008, 445).

Although providing a thorough empirical account is a central goal of the article, my principal theoretical interest lies in contributing to the enduring debate over the potential for productive engagement between political ecology and actor-network theory (ANT; see, e.g., Castree 2002; Lave 2015b), particularly the strain of ANT associated with the work of Latour (1993, 2005). Specifically, I aim to illustrate the value of ANT's network conceptualizations for understanding processes of socionatural assemblage and hybridization in ways that recognize both their historical materialist character and the emergent agency of the social and natural (and socionatural) actors they link.[1] In stark contrast to the recent suggestion that we should "retire ANT as a core element of the political ecology toolkit" due to incompatibilities with the field's core commitments and because "we have nothing to lose but our networks" (Lave 2015b, 221), I argue that careful attention to socionatural networks can help strengthen political ecology's fundamental commitments to elucidating the vital character of nonhuman nature in political–economic dynamics and to supporting more just and sustainable environmental governance.

In conceptualizing socionatural networks, I follow Rocheleau and Roth's (2007) suggestion that we understand them "as relational webs shot through with power," while broadening our "notions of power to incorporate the biophysical, material dimensions of these relationships" (434). This approach makes explicit "the ontological reality of those entities we term 'natural,' and the active role those entities play in making history and geography" (Castree 1995, 13) through a shift toward a more symmetrical and relational understanding of agency that avoids the excesses of both social constructionism and environmental determinism. Put differently, careful historical analysis of these relational webs aids in understanding how "agency becomes an emergent property of network associations rather than a property inherent in discrete entities," either social or natural (Bakker and Bridge 2006, 19).

I contend that this focus on the historical dynamics of actor articulation within network topologies makes the interactions and hybridizations that structure our worlds more comprehensible. For although network conceptualizations begin from and, to a degree, maintain the nature–society binary that nondualist framings reject, they also provide a more dynamic and imaginable terrain of socionatural melding than alloys like Haraway's (1991) *cyborgs* and Latour's (1993) *quasi-objects*. Moreover, these latter conceptualizations risk conveying a sense of amalgamation that can misrepresent the incomplete fusions and multiactor assemblages intrinsic to many socionatural systems. They also remain, I believe, too ontologically challenging to gain much traction in the public imagination,[2] whereas networks are a ubiquitous aspect of contemporary life and thought.

In an applied sense, I also argue—contrary to critiques of ANT's normative indifference—that a political–ecological network approach can support more just and sustainable environmental governance in at least two ways. First, through detailed attention to the socionatural metabolisms through which both social reproduction and economic production occur, a network approach helps to illuminate the competing and contradictory dimensions of these processes that often drive conflicts and distributional inequities over resource access and control. Second, understanding nature as an active component of socionatural systems rather than a passive substrate is fundamental to moving beyond an entrenched Prometheanism regarding the nonhuman—a shift ever more critical as we increasingly confront the diverse impacts of global change.[3]

The case study in which I ground my argument is based on fieldwork conducted in Peru from 2009 to 2017, with intensive data collection from 2010 to 2012 and several shorter research periods in 2009 and from 2013 to 2017. This work has included numerous and repeat interviews with diverse participants in the conflict and its resolution process (e.g., members and advisors of the local coalition, current and past employees of Duke Energy, and representatives of multiple government ministries and agencies). I have also undertaken participant observation in several dozen meetings and technical inspections related to the conflict, and I have studied the formal, written proceedings (*actas*) of many other such meetings. Additionally, I have collected and analyzed varied materials relevant to the case, including technical assessments and reports; hydrologic and climatic data and lake-level monitoring records; national- and local-level legislation, policies, and legal rulings; press releases and public and private correspondence between parties; and media coverage.[4]

The article is structured as follows. The next section examines select developments within critical political economy, political ecology, and ANT for conceptualizing nature–society dynamics and nature's agency and considers prior examples and further potential for linking these approaches in the analysis of socionatural systems. In the third and fourth sections, I apply a political–ecological network perspective to the empirical analysis of the Parón conflict's emergence and persistence. In the concluding section, I reflect on the value of this approach and argue for maintaining ANT within political ecology's conceptual toolkit.

Socionatural Networks and the Matter of Nature in Capitalism

Almost three decades ago, Fitzsimmons (1989) noted that, despite the discipline's "deep roots" in the topic, most work in critical geography showed a "peculiar silence" on the matter of "social Nature: the geographical and historical dialectic between societies and their material environments" (106). Today this silence is hard to fathom, because critical approaches to nature–society dynamics are a pillar of human geography and the central focus of political ecology. This section considers a selection of the scholarship that has emerged in these areas over recent decades, focusing specifically on work concerned with materiality and the agency of nature within the dynamics of late capitalism.

Marx was explicit about the central role of nature in social and economic reproduction—both in the *longue durée* of human history and in the rise of capitalism (Marx [1867] 1967). Nevertheless, Marx's work is often critiqued for a Prometheanism that "under-represents the significance of non-manipulable natural conditions of labour processes and over-represents the role of human intentional transformative powers vis-à-vis nature" (Benton 1989, 64). "Green" Marxists have responded extensively to this critique (Castree 1995), looking both theoretically and empirically at sectors like industrial agriculture to detail how material conditions present obstacles as well as opportunities for capital accumulation (e.g., Mann and Dickinson 1978; Henderson 1999). Focusing on capitalist dynamics broadly, O'Connor (1988) proposed an ecological Marxism that turns on a "second contradiction" (19), wherein continuous degradation of the "conditions of production" (11) on which capitalism's growth is based generates eventual crisis. Similarly, rejecting both "epistemic conservatism" and "social-constructionist utopianism," Benton (1989, 78) argued for a reconceptualization of labor processes that views the "complex patterns of enablement and constraint that are built into all forms of human interaction with nature … as a function of the articulated combination of specific social practices and specific complexes of natural conditions, resources and mechanisms" (78–79).

Building on such work, Boyd, Prudham, and Schurman (2001) drew an analogy to the distinction between the formal and real subsumption of labor (Marx [1867] 1967) to develop a framework for examining how the "problem of nature" is handled by specific industrial sectors. In their framework, nature's formal subsumption corresponds to extractive industries in which firms must confront nature's materiality and "adjust their production strategies to address the exigencies," whereas real subsumption occurs within biologically based industries where "systematic increases in or intensification of biological productivity" allow nature to be "(re)made to work harder, faster, and better" (Boyd, Prudham, and Schurman 2001, 562–64). Despite the heuristic value of this framework, varied socionatures—including the hydropeaking regime at Lake Parón described later—challenge such clear-cut categorization (Sneddon 2007), because eco-regulatory approaches typical of real subsumption proliferate across biologically and nonbiologically based sectors.

Over recent decades, the "neoliberalization" of nature has provided abundant material for political ecological analysis (see, e.g., McCarthy and Prudham 2004; Himley 2008; Bakker 2010).[5] Much of this work draws on the scholarship outlined earlier and other influential theories of nature in political economy (e.g., Polanyi [1944] 2001; Smith 1984; Harvey 1996) to critique nature's commodification and linked processes of resource dispossession, examining empirically how various industries place "social reproduction and the reproduction of the market (and capital) in tension over competing demands on biophysical nature" (Prudham 2004, 346). Given its focus on specific industrial metabolisms, this research often carefully considers materiality by examining how it both complicates and enables nature's economic subsumption (see Bakker and Bridge 2006; Braun 2008).[6] Yet much of this work is nevertheless critiqued for an "overly constrained view of agency," resulting from an implicit reliance on "a humanist view of the subject, and an associated anthropocentric conception of political subjectivity" (Bakker 2010, 717). Such perspectives tend to restrict agency to the realm of human intention, viewing the economy as "an already constituted structural unity *that only subsequently comes into contact with a recalcitrant non-human nature*" rather than recognizing how natural forces "shape or reconfigure the landscape of capitalism" from the outset (Braun 2008, 669). This critique resonates with broader concerns over political ecology's enduring tendency to privilege the political and economic over the ecological (Walker 2005; Lave 2015a). To address these critiques, political ecology can and should do more to explain how and why the matter of nature really matters in these processes, not just as input or backdrop but as constitutive participant.

Toward Symmetrical Agency

One theoretical tack for moving toward more active conceptions of nonhuman nature can be seen in geographic work coupling political–economic analysis with elements of ANT. For advocates of this union, "ANT goes beyond attentiveness to the material foundation of human action" through its premise that "agency is always a collective, networked outcome, performed by nondualist sociomaterial associations" (Goodman 2001, 193). This perspective on agency requires a symmetrical approach that privileges neither social nor natural forces a priori but instead considers how power emerges within "relentlessly heterogeneous" socionatural networks (Murdoch 1997b, 332). ANT thus challenges Promethean perspectives on nature by decentering power through a relational understanding of agency that includes as an agent "any entity which can link together others in networks" (Murdoch 1997a, 747). Understanding how agency emerges in particular contexts therefore requires detailed description of specific network dynamics without relying on preassumed social categories or motivations for explanatory power (Latour 1993). As Castree (2002) observed, "ANT refuses to look for causes lying *outside* socionatural networks" and "refuses the presumption that different networks are driven by the same general processes or factors, be they 'capital' or 'class interests' for example" (118–19).

Such perspectives challenge the structural presumptions of much critical political economy, leading to criticisms that ANT's symmetrical approach ultimately undermines social critique through normative distance and a disavowal of the importance of human intentionality (Pickering 1993; Murdoch 1997a). For many critics, the failure to grapple with social intentionality, in particular, overlooks how human actions drive the creation and modification of many socionatural networks and underestimates how nature's agency often emerges in relation to socioeconomic forces (Harvey 1996). Attention to human intentionality is undoubtedly vital to understanding how and why social actors enroll nature in specific networks, as well as the degree to which natural forces give rise to, enable, and disrupt social intentions. Acknowledging social intentionality does not, however, necessitate denying agency to natural actors but instead requires recognizing that processes driving actor networks "are social and natural but not in equal measure … and that power, while dispersed, can be directed by some (namely specific 'social' actors) more than others" (Castree 2002, 135). Latour (1993) himself underscored these dynamics when he stated, "The principle of symmetry aims not only at establishing equality … but at registering differences—that is, in the final analysis, asymmetries—and at understanding the practical means that allow some collectives to dominate others" (107–08). Contrary to imposing normative distance, this approach can aid in understanding—and confronting—injustice and domination by "disentangling the filaments which support the nodes of power" (Goodman 2001, 195; Whatmore 2002).

Although geographers have engaged with ANT too extensively to detail here (for reviews see Goodman 2001; Castree 2002; Braun 2008; Lave 2015b), several examples lay important groundwork for a political–ecological network approach. Sundberg (2011), for example, in what she termed posthumanist political ecology, showed how agency becomes a "collective performance, rather than the product of individual intention" (332) within historically contingent collectives of humans and nonhuman nature at the U.S.–Mexico border (e.g., federal agents, thorn scrub, and felines). Similarly, research on irrigation (Birkenholtz 2009) and drinking water (Sultana 2013) in India analyzes how social relations are embodied and transformed in networks formed around tubewells, which link actors including humans, technological artifacts, and institutions as well as groundwater and its contaminants. Blending political ecology and ANT explicitly, such approaches highlight agency's emergence within specific histories of network creation, an insight shared with earlier research on hybrid waterscapes.

Waterscapes and Hydrosocial Flows

The articulating fluidity and metabolic importance of water makes it a vital actor in many socionatural networks, and ANT has significantly influenced geographic scholarship on the "hydrosocial" dynamics of water use and governance. A seminal example is Swyngedouw's (1999) work on the early twentieth-century Spanish "waterscape," which draws explicitly on Latour to conceptualize the waterscape as a socionatural hybrid "that embodies a multiplicity of historical-geographical relations and processes" in ways that "express nature *and* society and weave networks of infinite liminal spaces" (445). Moreover, Swyngedouw (1999) argued that "following the maze of socionature's networks—as Latour (1993) suggests we do—is not good enough if stripped from the *process* of their historical-geographical production" (447).

Figure 1. Aerial photograph of Lake Parón and the upper reaches of the Parón–Llullán watershed. *Source:* Dirección de Vigilancia y Reconocimiento Aéreo de la Fuerza Aérea del Perú (National Aerophotographic Service of Peru).

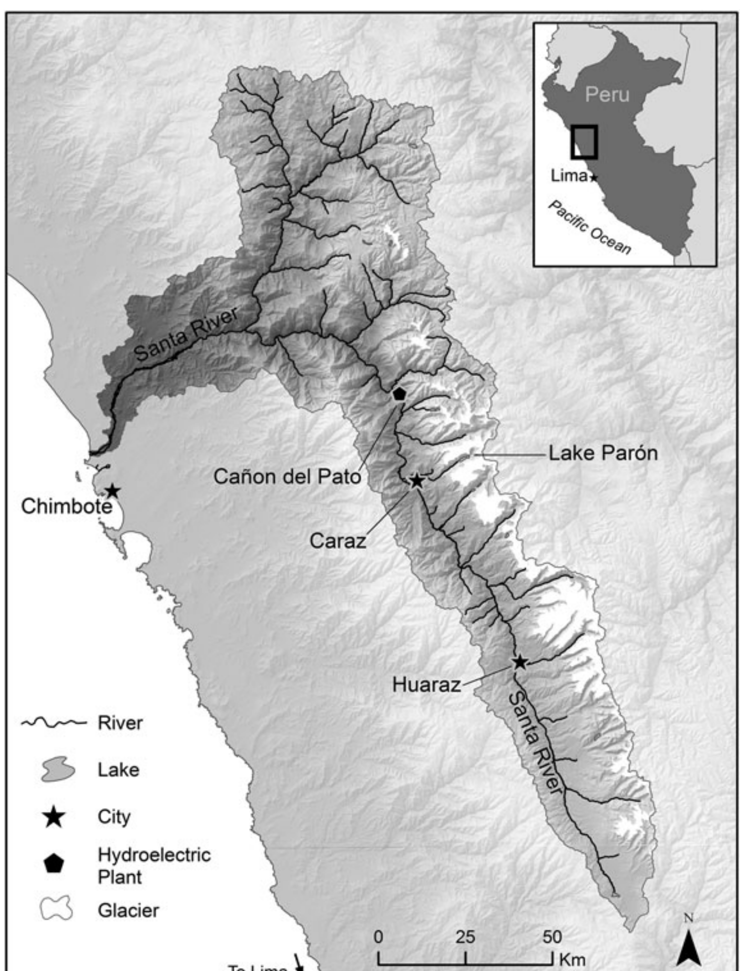

Figure 2. The Santa River watershed, Peru.

In other words, detailed description is insufficient without attention to the historical and material dynamics that continuously configure networks in ways transcending the nature–society divide. As Swyngedouw illustrated, these hybrid networks might highlight social intentions but always in relation to natural forces and processes.

Many geographers have followed Swyngedouw's ANT-inspired attention to hydrosocial dynamics through an analytical focus "envision[ing] the circulation of water … as a hybridized socionatural flow that fuses together nature and society in inseparable manners" (Swyngedouw 2009, 56; see, e.g., special issues introduced by Bear and Bull 2011; Budds, Linton, and McDonnell 2014; Boelens et al. 2016). Notably, this work rarely draws on ANT explicitly (Loftus 2011), perhaps due to the aforementioned perceptions of incompatability with the structural and dialectical approaches dominant in much hydrosocial theorizing (e.g., Lave 2015b). Whatever the rationale, I believe the this elision of ANT's influence on hydrosocial conceptualizations neglects a formative element of this scholarship and overlooks important conceptual insights ANT has to offer.

In an effort to recognize and extend ANT's contributions to hydrosocial research, in the following case study I link ANT's approach to networks and agency with political ecology's critical attention to history and power to examine the evolution of the Parón conflict. The analysis illustrates how social and natural actors have interacted and hybridized over time to coproduce and transform the network that shapes the hydrology as well as the political economy and governance of the Parón waterscape and its flows. Through attention to the constitutive roles of both materiality and science and technology in these dynamics, the approach responds to concerns over how political ecology "has increasingly distanced itself from the environmental sciences and from consideration of the physical characteristics of the landscapes it studies" (Lave 2015a, 572). Additionally, this work complements and advances interdisciplinary research on hydrosocial systems in Andean Peru (e.g., Bury et al. 2013; Mark et al. 2017), and on Lake Parón specifically (Carey 2010; Carey, French, and O'Brien 2012), through detailed analysis of the political economy of regional water governance as well as through heightened attention to socionatural hybridization and the complexity of agency in these networked processes.

The Lake Parón Waterscape

Lake Parón is the largest of more than 1,800 lakes in the Cordillera Blanca—the planet's highest and most extensively glaciated tropical mountain range (Glaciology and Hydrologic Resources Unit 2011; see Figure 1).[7] Impounded behind a glacial moraine at 4,200 meters above sea level (masl), the lake collects precipitation and glacial melt from a 42-km^2 watershed[8] to form the headwaters of the Parón–Llullán River, which descends over 20 km and 2,000 vertical meters to a confluence with the Santa River at the city of Caraz (Figure 2). The lake's outflow has long been vital to local agriculture and water supplies, particularly during the annual dry season (~May–October) when little precipitation falls. Currently, these flows provide water to more than 2,300 local irrigators and more than 20,000 residents of Caraz (Local Water Authority 2010).

Since the early twentieth century, however, diverse actors from beyond the hydrographic boundaries of the Parón–Llullán watershed have contributed to the transformation of the lake and its waterscape. Within this dynamic network, human actors and hydrologic and biophysical conditions have become linked in ways that illustrate both the importance of human intentionality in the creation of socionatures and the emergent agency of nature in enabling and defying its subsumption for human gain.

Histories of Water as Resource and Risk

The socionatural network at Lake Parón must be understood in the broader context of the Santa River waterscape to which the lake is linked. Fed by precipitation and glacial melt from the Cordillera Blanca, the Santa River has the second largest watershed (~12,000 km^2) and most consistent annual discharge of all the rivers on Peru's Pacific slope (Bury et al. 2013). Given the aridity of Peru's coastal plain, these perennial flows have made the river pivotal in regional development schemes. In 1906, for example, coastal agriculturalists began lobbying for the Santa's diversion northward for irrigation around Trujillo (Landeras 2004). In 1913, Peruvian engineer Santiago Antúnez de Mayolo proposed a hydropower plant along the Santa's middle reaches in the remote Cañon del Pato gorge (Antúnez de Mayolo 1957). Influenced by the engineer's 1912 visit to Norway's energy and fertilizer production facility at Rjukan, this integrated plan finally came to fruition in 1958, linking hydropower to steel production at the port of Chimbote (Sotelo 1982). Parón and other highland lakes played an important role in such plans for their capacity to provide water reserves during dry periods.

Transformation of Parón's waterscape, however, was first driven by fears of disaster rather than developmental visions. Here also the Santa waterscape is critical, because it is one of the planet's regions most susceptible to glacier-related hazards (Carey 2010). In the 1940s, fear of a catastrophic glacier lake outburst flood (GLOF) downstream of Lake Parón intensified after a nearby lake's morainal dam failed in 1941, unleashing a GLOF that killed 5,000 people and destroyed much of the city of Huaraz.[9] After this disaster, Caraz residents demanded risk reduction at Parón, even petitioning the Peruvian president to drain the lake in 1945 (Carey 2010). These pressures grew in 1950 when a GLOF originating two canyons north of Parón destroyed much of the nearly completed Cañon del Pato hydroelectric plant (CDPHP) and again in 1951 when Lake Parón itself nearly overflowed its dam after a series of small GLOFs entered the lake from a tarn upstream in the Parón basin.

The combination of nearby glacier-related disasters, uncertainty about the stability of Parón's morainal dam, and the exposure of downstream populations and infrastructure to GLOF hazard drew a variety of new actors into the Parón waterscape. These actors included not only alarmed citizens and the public officials they lobbied to control the lake but also the scientists and engineers called on to conduct analyses and risk mitigation. Parón's role as both a hydrologic resource and a potentially lethal hazard made the political dynamics around the lake particularly complex, with some actors demanding its drainage, whereas others argued for its preservation (Carey 2010). A number of cursory, and at times conflicting, technical risk assessments added uncertainty to this complexity. Finally, in 1967, after more than two decades of debate, a team of French scientists led by the respected glaciologist Louis Lliboutry was contracted to evaluate the dangers at the lake.

Gauging and Controlling Nature's Latent Power

The 1967 study detailed the geophysical processes that could generate a GLOF at Parón. These included seismic activity that might cause liquefaction or erosion of the morainal dam, unstable fossil ice within the moraine, or the overtopping of the dam as a result of wave action caused by rockfall or a GLOF in one of the smaller lakes upstream—as had nearly occurred in 1951 (Lliboutry, Post, and Pautre 1967). This analysis underscored the latent power of the natural components of the lake's waterscape, and despite the fact that these natural "actors" had long been present, their agency only emerged through documentation by credible experts.

Although the French scientists did not predict the probability of the dam's failure, they felt that the risks warranted the lake's immediate drainage to further analyze the dam's stability. Notably, their study also extended the debate over the lake's role as a water resource by suggesting that the stability assessment should determine the feasibility of using Parón as a regulating reservoir for the CDPHP, which in 1967 was in the process of doubling its generating capacity from 50 to 100 MW (Duke 2013).

Peruvian policymakers quickly approved the lake's drainage, but rather than risk destabilizing the dam by excavating a spillway in the moraine—as had been accomplished at several smaller Cordillera Blanca lakes—a 1.2-km tunnel would be drilled in the granite mountainside forming the lake's right bank. This complex and costly project began in 1968. After an array of technical and financial setbacks and the involvement of actors ranging from expert navy divers to a Swiss mathematician, the tunnel was finally completed in 1984 (Carey 2010). Over 1984 and 1985, the lake level was lowered by 45 m as 58×10^6 m^3 of water was discharged (S&Z 1986).

The dam's evaluation further expanded the role of engineers and science within the Parón waterscape. It included analysis of bathymetric, meteorological, and hydrologic data for the basin; collection of core samples from the moraine; and monitoring of the water table and stability of the lake's shorelines during drainage at variable discharge rates (S&Z 1986). These methods determined that the lake's moraine was well consolidated and free of fossil ice, that the shorelines were stable, and that seepage through the moraine diminished as the water level dropped below 4,190 m. Analysis of historic water availability and demand suggested that the lake could annually provide sufficient water for local needs ($\sim 18 \times 10^6$ m^3) while contributing a significant volume to the CDPHP ($\sim 27 \times 10^6$ m^3; S&Z 1986). The engineers thus concluded that the lake could effectively serve as a regulating reservoir under specific operating conditions.

These guidelines included maintaining the lake's maximum surface level at 4,185 masl, which would limit the total volume to 54×10^6 m^3 and leave 15 m of freeboard between the water surface and the dam's highest point to absorb impacts related to rockfall or an upstream GLOF. The intake for the discharge tunnel would be constructed at 4,155 masl, providing 36×10^6 m^3 of storage capacity. Notably, there was no recommendation for a maximum discharge rate in cubic meters per second; instead, the engineers suggested that the lake's surface level should be lowered by a maximum of 20 cm per day to assure the continued stability of the shorelines and dam. With these guidelines established, all that remained to convert the lake to a managed reservoir was the reinforcement of the drainage tunnel and the installation of discharge-controlling hydraulic valves. These final steps were completed by 1992 and, in infrastructural terms, Lake Parón was integrated into the CDPHP system.

Lake Parón's Formal Subsumption by the Energy Sector

Although the original rationale for "controlling" Parón had been risk reduction, there was also a strong profit incentive for incorporating the lake into the national energy grid. In 1990, Electroperú—the state energy company that owned the CDPHP—estimated that water from the lake would generate an additional $3 million per year in revenue (Carey, French, and O'Brien 2012). Part of this financial benefit was linked to the fact that Parón's water is clean, bearing little sediment in comparison to many other Santa River tributaries. As a result, its use at the CDPHP saves expensive erosive wear to the steel paddles that drive the plant's turbines (Ocaña 2011). More crucial, however, was the fact that Parón's volume could be stored and released strategically during the annual dry season when the Santa River drops to levels insufficient to generate at the CDPHP's full capacity.

To formalize Parón's use by the energy sector, a state-granted water license was awarded to Electroperú in late 1994 (Ministry of Agriculture [MINAG] 1994b). The license established a right to discharge 35×10^6 m^3/year—practically the entire usable volume of the lake—at rates up to 8 m^3/sec, which was more than three times the historical average maximum discharge (2.55 m^3/sec) from the lake between 1953 and 1983 (S&Z 1986).[10] To provide for local irrigation and potable water needs, the license also required a permanent discharge of at least 1 m^3/sec.

Despite the transformation of the lake's discharge regime that the license permitted, there was no environmental impact analysis (EIA) conducted prior to its approval. This lack of an EIA contradicted energy-sector regulations passed earlier in 1994 (Ministry of Energy and Mines [MEM] 1994)[11] and was particularly surprising given the lake's location within Huascarán National Park, one of Peru's flagship parks and a UNESCO World Heritage Site. Even more unusual was the fact that days after the granting of Electroperú's license, a state land registry titled 540 hectares of the national park, including Lake Parón and its watershed, to the energy company (French 2016). Eventually acknowledged by authorities as a titling "error," this land transfer did not draw public attention until years later when, as we will see later, it would come to play an important role in the conflict over Parón.[12]

The conversion of Parón to a managed component in the regional energy system significantly restructured the waterscape by linking diverse new actors to the lake and its flows. The most directly influential of these actors was Electroperú, who owned and operated both the CDPHP and Lake Parón's discharge infrastructure. As a node in Electroperú's network, the lake was connected to the regional energy grid and its expansive web of electricity producers and consumers. These included growing numbers of residential users, large coastal industries like steel and fishmeal producers, and a reinvigorated and expanding mining sector in the Andean highlands (Duke 2013).

This network would further expand after 1996, as neoliberal reforms privatized the entire CDPHP system through sale to the consortium Egenor (MEM 1996). In this process, the water license and property title for Parón were transferred directly from Electroperú to Egenor (MINAG 1996). Then, from 1999 to 2001, a subsidiary of U.S.-based Duke Energy consolidated control of Egenor and its holdings to become a central actor in the Santa and Parón waterscapes (Duke 2002). This privatization process created new, if indirect, links between the lake's waters and an increasingly diverse and distant array of social actors. Although neither Duke's international executives or shareholders nor the Andean irrigators depending directly on the lake were likely aware of each other's connections to Parón's flows, these actors had become articulated through the Parón waterscape, with each group gaining power to affect the other's interests.

As these political–economic networks expanded, the agential reach of the lake and its flows also grew. With the lake's conversion to a reservoir and the privatization of control over its outflow, the socionatural network at Parón took on new powers to enhance and impede national development and international profits. In this context, the lake's flows became an outcome of increasingly intricate hybridization. Their abundance and intensity were no longer determined by interacting geophysical factors such as precipitation, glacial melt, streambed gradient, and soil saturation but were instead dictated by the hydraulic valves at the tunnel intake, which could shift at a moment's notice with fluctuations in the value of a megawatt-hour of electricity or with the energy demand at the Chimbote steel mill.[13]

Toward the Real Subsumption of Lake Parón

As part of its privatization contract, Egenor agreed to increase generating capacity at the CDPHP from 150 MW to 240 MW (Duke 2001). This expansion would require additional water from the Santa and improved infrastructure to handle these larger volumes. Between 1998 and 1999, the corporation built a new, reinforced intake and renovated the plant's six pairs of turbines. With each turbine group requiring 12 m^3/sec of flow, the plant used 72 m^3/sec of river water when generating at full capacity, and Peruvian authorities increased the company's water allocation from 48 m^3/sec to 79 m^3/sec (MINAG 1999). This legal allocation alone did little good during the annual dry season, however, when Santa River base flows often drop to 35 m^3/sec or less at the CDPHP intake (National Water Authority [ANA] 2009b).[14]

Under dry-season conditions, expanded power generation required additional water in the river, flows most readily available from highland lakes like Parón. As noted earlier, Duke's water license for Parón permitted the discharge of up to 8 m^3/sec. Once released, this water traveled approximately eight hours to reach the plant's turbines, during which an estimated 20 percent was lost to evaporation, filtration, and upstream uses.[15] Thus, although a substantial addition to the Santa's dry-season base flow, Parón's contribution at the CDPHP was insufficient to power even one additional turbine group during the several hours each evening when energy demand—and its market price—was typically highest.

Maximizing generating capacity during these periods of peak demand required storing large volumes of water close to the CDPHP's intake to be released strategically through a process known as *hydropeaking*. In 2001, Duke enhanced its hydropeaking capacity at the CDPHP by constructing a 684,000-m^3 regulating-reservoir system on an alluvial plain upstream of the plant's intake. This new element in the waterscape, the San Diego Reservoir, allowed Duke to divert water from the Santa during periods of lower energy demand to fill two linked holding ponds. This water could then be emptied back into the Santa at a rate of up to 50 m^3/sec, more than doubling the river's average minimum dry-season flow at the intake ($\leq$35 m^3/sec) and supporting generation at or near full capacity during peak hours throughout much of the dry season.[16] Lake Parón, meanwhile, provided critical water to speed San Diego's daily recharge, enabling more consistent generation at the CDPHP for the sustained demand of users like factories and mines (Ocaña 2011).

This system capable of responding to peak energy demand in virtually real time shifted the use of Lake Parón and the Santa's flows at the CDPHP away from the formal subsumption characterizing a basic run-of-the-river hydropower plant toward an eco-regulatory real subsumption capable of manipulating natural conditions to enhance economic productivity. This shift was initiated by strategically incorporating the annual hydrologic regime at highland lakes cum regulating reservoirs into the energy-production system and then enhanced through human-constructed storage capacity that maximized the economic efficiency of combining seasonally produced reserves with the river's base flow.

This hydropeaking arrangement was particularly valuable from 2004 to 2008, when energy producers like Duke could forego contracting their production in advance, instead leaving it available for speculation on a short-term market where it could yield substantially higher prices than those for contracted production (Figure 3; Peru 1992). During periods when these spot-market prices were highest (typically during annual dry seasons when hydropower production was reduced), there were strong financial

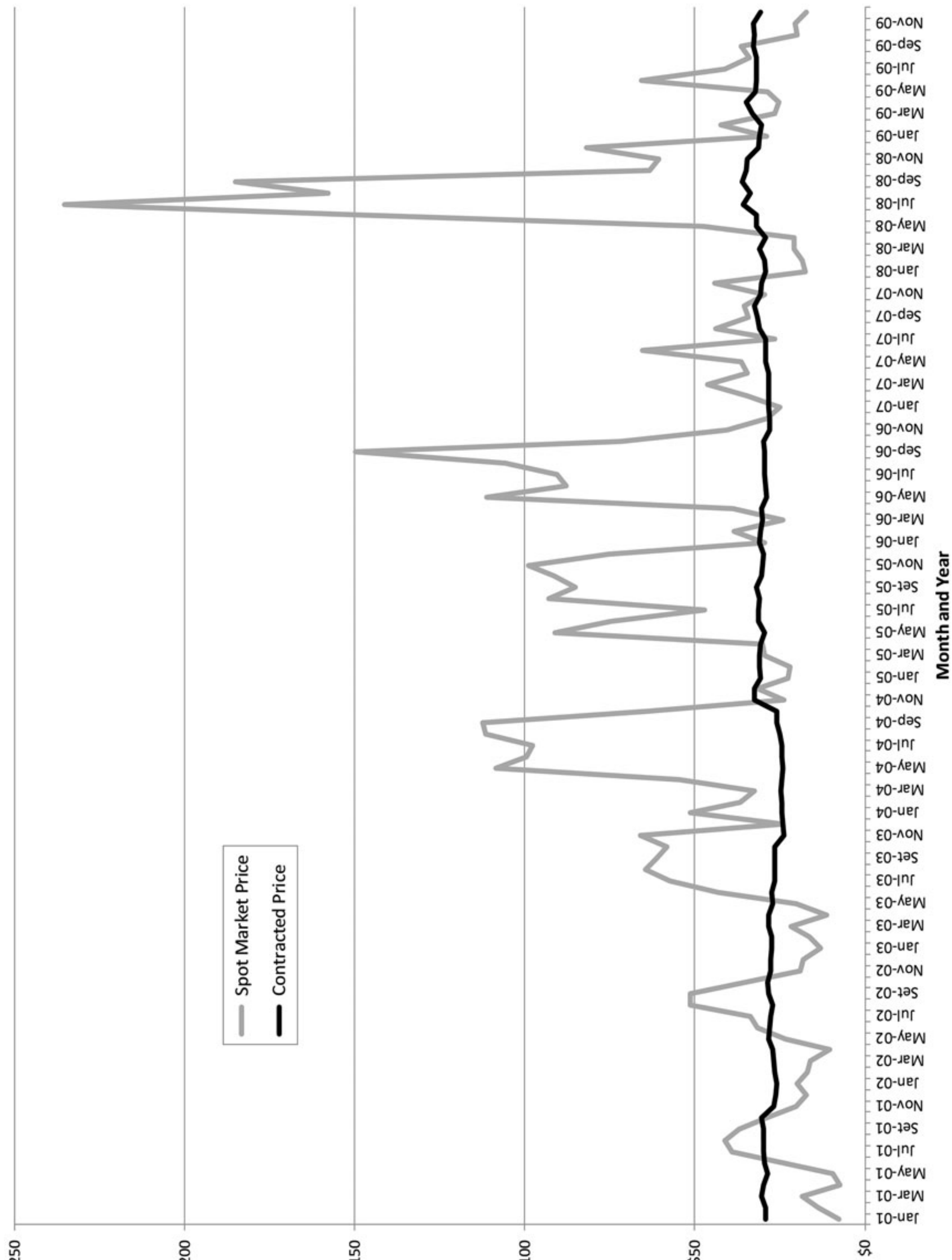

Figure 3. Prices for energy generation in Peru, 2001–2009: Long-term contracts versus spot market. *Source:* Data from Committee for the Economic Operation of the National Interconnected Energy System (COES).

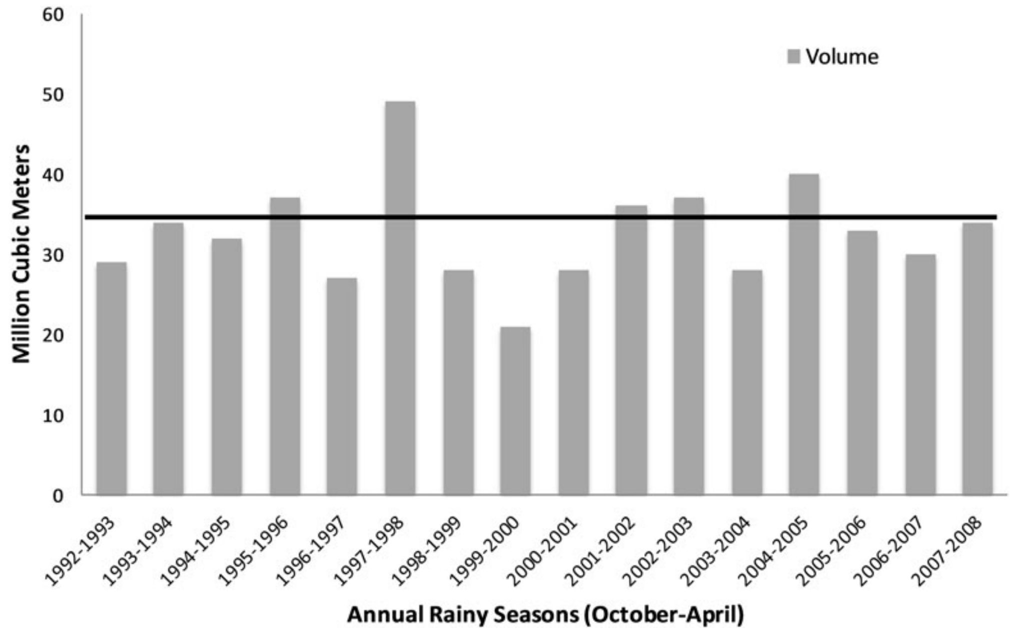

Figure 4. Annual recharge of Lake Parón, 1992–2008. *Note:* Black line represents the licensed annual discharge for hydropower production ($35 \times 10^6 m^3$). *Source:* Data from the National Water Authority (Glaciology and Hydrologic Resources Unit n.d.; Technical Administration of the Huaraz Irrigation District n.d.).

incentives to manage reservoirs like Lake Parón and San Diego as intensively as possible.[17]

From Contradictions to Conflict

Whereas Duke's license supported intensive management of Parón as a regulating reservoir, local geomorphologic conditions and water uses did not. Specifically, two major material contradictions arose between the licensed use regime and the socionatural characteristics of the waterscape. The first of these stemmed from the fact that some riverbanks and infrastructure in the Parón–Llullán watershed were unable to sustain the erosive power of discharges at the upper end of the licensed range (~5–8 m^3/sec). The second contradiction was linked to the volumetric recharge of the lake during the annual wet season, which varied with climatic factors[18] and the lake's management and was not always sufficient to recuperate the volume allotted annually for hydropower generation (35×10^6 m^3; Figure 4).

Given these contradictions, soon after Duke brought the San Diego reservoir into use, formal complaints over Parón's management arose. First, in late 2001, the mayor of the Municipality of Huaylas[19] requested the revocation of Duke's license over damages to local roads, bridges, and irrigation canals resulting from an "indiscriminate use of Lake Parón's waters in quantities greater than that of the normal flow of the Llullán River" (Huaylas 2001).[20] Similar complaints from local residents and the potable water provider for Caraz, whose water treatment infrastructure regularly suffered damages from large discharges and increased levels of turbulence, continued over the ensuing years (e.g., EPS Chavín 2007). These impacts were not surprising given that the Parón–Llullán River's streambed morphology and local uses had been influenced by a flow regime in which the average maximum discharge for at least the several decades prior to the tunnel's construction (1953–1983) was merely 2.55 m^3/sec and the maximum documented discharge (1983) was just 4.23 m^3/sec (S&Z 1986). As the sustained complaints emphasized, the river course and local infrastructure could not withstand flows more than three times the average maximum without significant damage.

In contrast to excessive discharges, the second contradiction reflected too little water for local needs. At the end of the 2002 dry season, the president of the Parón–Llullán Irrigator Commission submitted a complaint to the state water authority over crop losses due to insufficient water releases from the lake, which violated the agreement to maintain a permanent discharge of 1 m^3/sec (Parón-Llullán 2002). Duke responded to such grievances by appealing to its licensed rights. For example, a year earlier

Table 1. Lake Parón's discharge regimes

	Average annual maximum (1953–1983)	Legal license (1994–2006)	Legal license (2006–2007; 2011–present)	AACHS suspension (2007–2011)	Rate set by local coalition after 2008 seizure	Technical recommendation for maximum
Discharge rate (m^3/sec)	2.55	8	5.5	2.63	1	4

Note: AACHS = Autonomous Authority of the Santa River Watershed.

the company had justified emptying Parón's entire usable volume with the statement, "2001 was a dry year that forced those in charge … to drain Lake Parón to the authorized levels" (Duke 2002, 30). The company went on to explain that the lack of water was temporary and that by mid-2002 the lake was mostly replenished. Nevertheless, the Irrigator Commission's complaint several months later suggested that the problem, albeit temporary, was also cyclical and prone to reoccur each dry season, when water needs were greatest across sectors.

As the grievances illustrated, the company's intensive management, although supported by its license, was incompatible with other elements of the Parón waterscape. Moreover, the licensed discharges that eroded riverbanks, damaged canals, and exhausted local water supplies contradicted national-level regulations governing Huascarán National Park and the Peruvian energy and water sectors (e.g., MEM 1994). Had factors such as historical flow rates, interannual recharge variability, and streambed morphology been considered in the original license's design, a more balanced and adaptive discharge regime might have resulted. As it was, neither these aspects of the waterscape nor the potential impacts of the licensed discharge regime on local water uses figured in the license. By ignoring Parón's preexisting socionatural network and disregarding its potential to present obstacles to the lake's subsumption by the energy sector, policymakers awarded a license destined to engender conflict.

As Duke adhered to its licensed rights despite the impacts, diverse state authorities were drawn into the waterscape to address the mounting complaints. From 2004 to 2006, Huascarán National Park and the state's Supervisory Agency for Energy Investment (OSINERG) conducted formal inspections, confirming reported damages and requesting a detailed EIA for Duke's use of Parón (e.g., OSINERG 2006). In 2006, water-sector officials took stronger action, modifying Duke's license permanently by reducing the maximum discharge rate from 8 to 5.5 m^3/sec—still more than double the historical average maximum flow (MINAG 2006). In August 2007, amidst continued complaints over Duke's management and increasing concerns that the conflict might turn violent, the Autonomous Authority of the Santa River Watershed (AACHS)—nominally the basin's highest water authority (MINAG 1994a)—suspended Duke's rights to use Parón until Peru's judiciary could rule on a request by Caraz's mayor to revoke Duke's license (AACHS 2007).[21] Following this order, the discharge rate was limited to 2.63 m^3/sec for local uses until the matter could be settled in court (MINAG 2007). After appeals by both sides, the case passed into the higher echelons of the legal system. Then in July 2008, with the legal decision still pending, Duke began discharges in excess of 2.63 m^3/sec. The local coalition—consisting of members of the Cruz de Mayo *campesino* community, the Parón–Llullán Irrigators Commission, and residents of Caraz[22]—took swift action, occupying the lake's infrastructure and fixing the discharge at 1 m^3/sec (Table 1). In 2017, local residents still guard the lake and its discharge infrastructure in the absence of any permanent resolution to the conflict.

The Matter of Agency

Over the nine years since the coalition's occupation of Lake Parón, the web of actors connected through the waterscape has continued to expand. This growth in the network has been most obvious in relation to the social actors who became involved as the case garnered interest from an array of politicians, journalists, and nongovernmental organizations, including Peru's former First Lady Nadine Heredia and the Episcopal Commission for Social Action (CEAS).[23] Whereas the attention of many such actors has been fleeting, the involvement of advocates like CEAS has endured and helped to shape the trajectory of the resolution process. Given the conflict's duration coupled with structural changes within Peru's bureaucracies, a diverse and shifting cast of state institutions and functionaries has also engaged in the resolution efforts, from conflict resolution experts to top-level ministers.

Yet, although varied and influential social actors have come and gone over years of conflict resolution efforts, the forces impelling action have most often been natural processes and their socionatural entanglements. Next, I highlight several important moments in the conflict's evolution to illustrate how agency—rather than being wielded unilaterally by powerful social actors—has instead emerged within the socionatural network of the engineered, but ultimately unpredictable and uncontrollable, Parón waterscape.

The Agency of Matter

During the wet seasons of 2008–2009 and 2009–2010, abundant precipitation coupled with the local coalition's decision to maintain the discharge at 1 m^3/sec caused Lake Parón to fill to levels that forced repeated efforts to resolve the conflict. The lake first surpassed the maximum "safe" level of 4,185 masl in February 2009, leading the National Water Authority to order controlled discharges (ANA 2009a). The local coalition refused, however, insisting that the registry "error" from 1994 titling Lake Parón to the energy sector first be annulled. This did not occur, and the lake level continued to rise, hovering around 4,190 masl for the remainder of the 2008–2009 wet season before dropping gradually during the dry season.

Throughout 2009 the discharge remained fixed at 1 m^3/sec, and with heavy rains late in the year, the lake level quickly rose, reaching almost 4,195 masl by the end of the year. With only 5 m of freeboard remaining and significant seepage passing through the morainal dam, the National Water Authority again pressed for controlled discharges. Yet despite the growing hazard, the local coalition refused to cooperate while the titling error remained unresolved.

With the lake in this precarious condition, on 3 January 2010, natural forces intervened further when a 5.7 magnitude earthquake with an epicenter roughly 10 km north of Parón, struck the region (Tavera, Bernal, and Torres 2010). The lake's saturated dam survived, but the earthquake accentuated public concern over the growing risk. Soon afterward a presidential decree declared a national state of emergency at Lake Parón, mandating controlled discharges (Presidency of Council of Ministers 2010). Yet the steadfast coalition refused even this executive order, with some residents proclaiming that they "would rather die in an avalanche than of thirst" (Untiveros 2011, 9). Finally, in early February, a second executive order annulled the erroneous property title and returned Lake Parón to Huascarán National Park (Ministry of the Environment 2010). Several days later, after the minister of agriculture visited Parón and assured the local community that its priorities would determine the lake's management in the future (Cordova 2010), the coalition permitted the lake's lowering for the first time since the 2008 occupation (Peralta 2010).

The Matter of Politics

For many observers, the lake's lowering in early 2010 followed by collaborative management of its volume throughout the 2010–2011 rainy season marked the conflict's resolution. Nevertheless, neither the annulled titling error nor the temporarily successful management efforts addressed the principal drivers of the conflict. As described earlier, these were rooted in the details of Duke's water license, which remained the subject of an ongoing legal suit.

In May 2011, Peru's Constitutional Tribunal finally ruled on the 2007 suspension of Duke's license (Peru 2011), overturning it and upholding Duke's right to discharge 35×10^6 m^3 from Lake Parón at rates up to 5.5 m^3/sec, despite the fact that experts had recommended a maximum discharge rate of 4 m^3/sec (ANA 2010). The high court's decision, which undermined such technical recommendations as well as the minister of agriculture's assurances from 2010, focused on jurisdictional details and procedural errors in the suspension process and failed to consider the history of local complaints and the license's contradiction of other national legislation. Most important, the ruling utterly ignored the matter of nature at the lake and the recurrent challenges it posed to the licensed discharge regime through the variable hydrologic conditions and geomorphology of the Parón basin. The local coalition decried the ruling as the result of state politics defending "the interests of economic power" and as "an affront to the life and dignity of the population" (Huaylas, Cruz de Mayo, and Parón–Llullán 2011). Local actors refused to honor the ruling, and the decision's principal outcome, besides upholding Duke's formal rights, was to spur the dissolution of the multisectoral committee that had managed the lake's level since early 2010 (ANA 2011). As a result, the ruling assured that the conflict would continue to ebb and flow with the volume of the lake for years to come.

Since the Constitutional Tribunal's ruling, ad hoc and protracted negotiations have repeatedly been required to manage the lake's level (French 2016). Yet despite the frequency and costs of such interventions, there has yet to be a formal initiative to permanently modify Duke's license in favor of a more adaptive arrangement responsive to the highly variable and unpredictable socionature of the Parón waterscape.

Conclusion

Through one critical optic, the Parón conflict can be understood as a double movement consisting of the subsumption of the lake's waters by the hydropower sector—a process that generated basic contradictions between social reproduction and economic production in the waterscape—and local society's ensuing efforts to re-embed the lake's vital flows in a system of customary use and control (Polanyi [1944] 2001). This is a perspective common to political ecology, and in its very framing, the agency of human actors and the economy they create is prominent, whereas nature merely provides a material basis for human intention and action. Responding to critiques of such anthropocentric approaches, this article couples political–economic analysis with ANT-inspired attention to how materiality has fundamentally shaped the web of actors in the Parón waterscape and the processes leading up to and following the energy sector's attempted subsumption of the lake's flows. This approach provides a more symmetrical perspective on socionatural dynamics, illustrating how a fuller understanding of agency results from detailed description of the networked historical geographical processes through which power emerges. The case underscores the limits of social power, showing that, although feats of engineering and infrastructure development succeeded in making the lake and its hydrologic regime work for the hydropower sector, the energy economy's subsumption of the lake and its flows falls far short of complete control over the resulting socionature. Instead, nature is always an integral and active partner in coproducing the waterscape—at times inspiring and enabling human enterprise and in other moments constraining human intentions and power.

In an applied sense, the analysis presented illustrates how little systematic attention has been paid to nature's role in the emergence and persistence of the Parón conflict, highlighting a broader need for recognition of materiality's constitutive character in shaping resource economies and politics in concert with human endeavor. Such awareness is vital to understanding how specific socionatural processes and outcomes generate the tensions and contradictions between social reproduction and economic production that underlie many intractable socioenvironmental conflicts under capitalist development. In elucidating these contradictions, a network approach can help political ecology deliver the critical, cross-disciplinary analyses that originally defined the field, while supporting transformative politics based in more just social relations and less Promethean relations with nature (cf. Loftus 2011).

Despite advocating careful attention to environmental determinants, it is important to emphasize that the approach taken here refutes rather than reinforces the excesses of environmental determinism. As the case study illustrates, instead of a power wielded by individual actors—either social or natural—agency is an outcome emerging from the specific relations of environmental and social factors connected within networks. For example, it would be wrong to suggest that the earthquake that helped impel the resolution of the titling error and the subsequent lowering of the lake in early 2010 alone forced these outcomes. Instead, the conjuncture of a lake filled beyond its maximum safe level, the presence of lives and infrastructure in the path of a potential GLOF, widespread public awareness of the conflict at the lake, and a legal process for correcting the title error already in process all contributed to swift action after the earthquake. A key point here is the critical importance of thorough empirical investigation in assembling the intricate and shifting socionatural webs in which the dynamics of agency and action evolve. Absent careful empiricism, the traps of determinism—both environmental and social—may plague the networks and the explanations that their structures and dynamics suggest.

As a final point, though the webs and flows described in this article reflect the socionatural hybridization inherent to our contemporary world, they also maintain, in a semantic and ontological sense, the fundamental nature–society binary that many scholars—and proponents of ANT in particular—have struggled to overcome. I believe that acknowledging this persistent divide is unavoidable, because although I advocate careful theoretical and empirical attention to processes of hybridization, I argue that continued recognition of this dualism is necessary to represent the intentional and incomplete fusions that often characterize human relations with nature. In light of the enduring ontological challenges this separation presents, the potential for network conceptualizations to capture and convey the complex assemblages of social and natural actors and the hybridized socionatures they produce is all the more vital. Thus, rather than retiring ANT from political ecology's toolkit and neglecting its contributions and conceptual insights, I suggest that we develop more thorough theoretical and empirical understandings of socionatural networks to enrich political ecology's attention to the matter of nature and the hybrid dynamics through which agency and power emerge.

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Notes

1. In an effort to avoid semantic confusion, I refrain from using the ANT term *actants* and instead use the term *actors* to represent the full spectrum of social and natural phenomena (i.e., humans, technological artifacts, biophysical forms and processes, geologic forces, etc.).
2. Castree's (2003) observation of this challenge within geography still holds for the discipline and for broader society: "Since it is scarcely plausible that physical geographers will be responsive to such ontological neologisms as 'imbroglios' and 'quasi-objects' (and who can blame them?!), it is likely any meaningful reunion of geography's two 'halves' will be achieved within existing binary mindsets" (206).
3. Rather than embracing Malthusian thinking, I concur with Benton (1989): "To recognize that specific social and economic forms of life encounter real natural limits is to concede nothing to natural-limits conservatism" (79).
4. Many of these materials are not available in public repositories or archives but were obtained directly from respondents and may be requested from the author. Due to confidentiality considerations, only materials within the public domain have been explicitly referenced here.
5. Given space constraints, I refer readers to several complementary review articles rather than excluding much excellent scholarship by citing only a few examples.
6. See previous note.
7. The Cordillera Blanca is undergoing rapid glacial recession, having lost more than 30 percent of its glaciated area since the 1970s. This glacier loss contributes to geophysical hazards and is affecting local and regional hydrologic regimes in diverse ways (see, e.g., Mark et al. 2017). Despite the fact that the Parón watershed has a relatively high percentage of glacier-covered surface area (~39 percent in 2009; see Baraer et al. 2012), annual precipitation remains the critical factor for Lake Parón's water supply, with glacial melt playing a much less significant role. Although concerns over future water scarcity linked to climate change have been mentioned by local actors, these were never identified as a significant driver of the conflict.
8. The term *watershed* refers to the hydrographic unit describing an area that collects and channels surface water, groundwater, and precipitation toward a common outlet. The term is distinct from *waterscape*, which conceptualizes a network encompassing the physical watershed as well as the diverse socionatural processes linked to and through it.
9. A GLOF results when the morainal or ice dam containing a glacial lake fails, allowing the impounded lake to drain. Processes including erosion, seismic activity, and avalanches often trigger GLOFs. Lake Parón's capacity ($\sim 79.5 \times 10^6 m^3$) coupled with uncertainty over the stability of its morainal dam made it particularly menacing as a GLOF hazard.
10. Measured by Electroperú at a stream-stage gauge at 4,100 masl on the Parón River. This volume

is slightly greater than the lake's discharge alone, because it includes runoff from an additional 7 km^2 (S&Z 1986). Post-1983 data are not included because the lake's discharge was then manipulated by human engineering.

11. The 1986 recommendation to use Lake Parón as a regulating reservoir predated the introduction of EIAs to Peru's environmental policy in 1990 (see Legislative Decree No. 613-1990).
12. Despite multiple inquiries regarding this titling error, its history was never explained definitively. By 2002, Duke reported that it was working to correct the error (Duke 2002), but the annulment of the title would not occur until 2010.
13. Interview with former Duke employee, 21 December 2010, Huaraz, Peru.
14. Combined average for August streamflows measured at stream-stage gauges located on the Los Cedros tributary (1,990 masl) and at La Balsa (1,880 masl) on the Santa River. The combination of these volumes gives the most accurate measure available for the streamflow at the CDPHP intake (1,807 masl).
15. Interview with Duke engineer, 3 June 2011, Huallanca, Peru.
16. See previous note.
17. From 2006 to 2008, Peru's government enacted various policies to regulate the short-term market and control its elevated prices (e.g., Law No. 28832; D.U. 049-2008; Peru 2006).
18. Of climate-related factors, precipitation levels affect the lake's recharge most substantially, although glacial melt rates also contribute. Although the El Niño–Southern Oscillation phenomenon influences both factors, its impacts vary nonuniformly between events in this part of the Andes; that is, precipitation and melt levels increase during some El Niño years and decrease during others (see Vuille, Kaser, and Juen 2008).
19. Huaylas is the province in which both Caraz and Lake Parón are located.
20. All translations by the author.
21. Interview with former President of the Directorate of the AACHS, 8 February 2011, Huaraz, Peru. Notably, in contrast to many recent socioenvironmental conflicts in Peru, no violence has occurred in the Parón case.
22. After the occupation at the lake, the local coalition would receive sustained public support from the Mayor of the Municipality of Huaylas and the potable-water provider EPS Chavín.
23. On Heredia's involvement, see "Carta de Nadine Heredia" (2011).

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